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MANUFACTURING METHOD FOR LIQUID CRYSTAL PANEL AND SUBSTRATE STICKING DEVICE

[Abstract]

PROBLEM TO BE SOLVED: To provide a manufacturing method for a liquid crystal panel, by which manufacturing stages can be simplified and to provide a substrate sticking device used for the method.

SOLUTION: In a substrate sticking stage, a lower substrate 4 is attracted to a lower surface plate 2 through an elastic body 5 in which attracting holes 51 are formed with a pitch 52 which is integral multiple of a pitch 22 of an attracting grooves 21 of the lower surface plate 2. After the positioning of an upper and a lower substrates 3 and 4 is performed, the substrates are stuck to each other by

pressing the substrates through an upper surface plate 1 and the lower surface plate 2 to crush a sealing resin 6. Even if the surface working precision of the upper and the lower surface plates 1 and 2 is insufficient, sticking and uniform pressing of the upper and the lower substrates 3 and 4 can be simultaneously performed and a pressing stage for crushing the sealing resin, which has been conventionally needed after the substrate sticking stage, is not required and the manufacturing stages can be simplified.

【Claims】

【Claim 1】 A method for manufacturing a liquid crystal panel, comprising the steps of: applying sealing materials for attaching a pair of substrates on any one substrate of the pair of substrates and sealing the liquid crystal into the pair of substrates; attaching the substrates by way of pressing the sealing materials through vacuum absorbing any one substrate from the pair of substrates using a substrate attaching apparatus, which includes an upper base plate and a lower base plate, to an absorption surface provided with an absorption groove or absorption opening for the lower base plate via an elastic body having absorption opening between the substrates, and opposing and aligning the pair of substrates with vacuum absorbing the other substrate to an absorption surface of the upper base plate, and pressurizing the pair of substrates via the upper and lower base plates between the substrates; wherein a pitch of the absorption opening in the elastic body suppresses pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate with regard to the substrate attaching process, and the pitch is n times or 1/n times the pitch of the absorption groove or opening in the lower base plate, whereby n is an integral number.

【Claim 2】 A method for manufacturing a liquid crystal panel, comprising the steps of: applying sealing materials for attaching a pair of substrates on any one substrate of the pair of substrates and sealing the liquid crystal into the pair of substrates; dropping desired amounts of liquid crystal materials on any one substrate from the pair of substrates; attaching the substrates by way of pressing

the sealing materials through vacuum absorbing any one substrate, on which the liquid crystal materials are dropped, from the pair of substrates using a substrate attaching apparatus, which includes an upper base plate and a lower base plate in a chamber, to an absorption surface provided with an absorption groove or absorption opening for the lower base plate, via an elastic body having absorption opening between the substrates, and opposing and aligning the pair of substrates with maintaining the vacuum degree of the chamber lower than the vacuum absorption power of the substrate in the chamber, and pressurizing the pair of substrates with interposing the upper and lower base plates between the substrates; wherein a pitch of the absorption opening in the elastic body suppresses pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate with regard to the substrate sticking process, and the pitch is n times or 1/n times a pitch of the absorption groove or opening in the lower base plate, whereby n is an integral number.

【Claim 3】 The method of Claim 2, wherein the vacuum degree of the vacuum absorption of the substrate formed by the upper and lower base plates in the substrate attaching process, is maintained below $0.1 \times 1.33322 \times 10^2$ Pa, and the vacuum degree of the vacuum chamber is maintained from $0.5 \times 1.33322 \times 10^2$ Pa to $1.0 \times 1.33322 \times 10^2$ Pa.

【Claim 4】 An Apparatus for attaching substrates, wherein the apparatus includes an upper and lower base plates provided with an absorption groove or opening at respective absorption surfaces of the substrates, a pair of substrates are absorbed to the upper and lower base plates so as to be maintained at

predetermined intervals thereby enabling position alignment, the pair of substrates can be pressurized via the upper and lower base plates between the substrates, an elastic body with an absorption opening is arranged incidentally to an absorption surface of the lower base plate, and a pitch of the absorption opening in the elastic body is n times or 1/n times a pitch of the absorption groove or opening of the lower base plate, whereby n is an integral number.

【Claim 5】 The Apparatus of Claim 4, wherein the upper base plate and the lower base plate provided with the elastic body are arranged in the chamber, in which an inner pressure can be adjusted.

[Title of the invention]

MANUFACTURING METHOD FOR LIQUID CRYSTAL PANEL AND SUBSTRATE STICKING DEVICE

【Detailed Description of the Invention】

【001】

【Field of the Invention】

The present invention relates to a method for manufacturing a liquid crystal panel and apparatus for sticking substrates using same.

【002】

【Description of the Prior Art】 FIG. 3 shows a conventional schematic cross-sectional view of a sticking process in a manufacturing method for a liquid crystal panel. As shown in FIG. 3, in the conventional liquid crystal manufacturing process, sticking was performed after upper and lower substrates 3, 4 had been stuck directly in a vacuum circumstance on upper and lower base plates 1,2 to thereby align the upper and lower substrates 3, 4.

【003】

【Problems to be solved by the Invention】 Although the degree of precision in cell gaps required for the liquid crystal panel is below ±0.3 μm for TN panel, and below ±0.05 μm for STN panel, the planar machining degree of precision of the upper and lower metallic base plates 1, 2 with regard to the above precision degree can not be expected more than ±20 μm. Accordingly, in the conventional sticking process of the substrates, it is impossible to press upper and lower substrates 3, 4 uniformly, and it is necessary to press the upper and lower substrates 3, 4 using separately prepared press after the above sticking process,

and to press sealing resins to a desired amounts, in order to obtain required degree of precision of the cell gaps. Thus, separate pressing process has been required to press sealing resins 6 after the conventional sticking process of the substrates.

【004】 The object of the present invention is to provide a method for manufacturing a liquid crystal panel, in which simplification of the manufacturing process can be achieved, and an apparatus for sticking substrates using same.

【005】

【Means for Solving the Problem】 According to the method for manufacturing a liquid crystal panel described in claim 1, the method is characterized by comprising the steps of: applying sealing materials for sticking a pair of substrates on any one substrate of the pair of substrates and sealing the liquid crystal into the pair of substrates; sticking the substrates by way of pressing the sealing materials through vacuum absorbing any one substrate from the pair of substrates using a substrate sticking apparatus, which includes upper base plate and lower base plate, to an absorption surface provided with absorption groove or absorption opening for the lower base plate, via an elastic body having absorption opening between the substrates, and opposing and aligning the pair of substrates with vacuum absorbing the other substrate to an absorption surface of the upper base plate, and pressurizing the pair of substrates with interposing the upper and lower base plates between the substrates; wherein a pitch of the absorption opening in the elastic body suppresses pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate with

regard to the substrate sticking process, and the pitch is n(n is a integral number) times or 1/n times a pitch of the absorption groove or opening in the lower base plate.

【006】 According to the manufacturing method of claim 1, the substrate sticking process is carried out by absorbing any one substrate to the lower base plate via the elastic body on which absorption opening is formed, and performing position alignment, and then pressing and sticking sealing materials between the pair of substrates. Although the planar machining degree of the upper and lower base plates is not sufficient, it is possible to pressurize them equally with sticking the pair of substrates simultaneously to thereby remove the pressurizing process for press the necessary sealing materials after the conventional substrate sticking process, and achieve simplification of the manufacturing process. In addition, as the pitch of the absorption opening in the elastic body is made to be n(n is a integral number) times or 1/n times the pitch of the absorption groove or opening in the lower base plate to thereby suppress pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate, and accomplish liquid crystal panel with equal cell gaps.

【007】 According to the method for manufacturing a liquid crystal panel described in claim 2, the method is characterized by comprising the steps of: applying sealing materials for sticking a pair of substrates on any one substrate of the pair of substrates and sealing the liquid crystal into the pair of substrates; dropping desired amounts of liquid crystal materials on any one substrate from the pair of substrates; sticking the substrates by way of pressing the sealing

materials through vacuum absorbing any one substrate, on which the liquid crystal materials are dropped, from the pair of substrates using a substrate sticking apparatus, which includes upper base plate and lower base plate in a chamber, to an absorption surface provided with absorption groove or absorption opening for the lower base plate, via an elastic body having absorption opening between the substrates, and opposing and aligning the pair of substrates with maintaining the vacuum degree of the chamber lower than the vacuum absorption force of the substrate in the chamber, and pressurizing the pair of substrates via the upper and lower base plates between the substrates; wherein a pitch of the absorption opening in the elastic body suppresses pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate with regard to the substrate sticking process, and the pitch is n(n is a integral number) times or 1/n times a pitch of the absorption groove or opening in the lower base plate.

【008】 According to the manufacturing method of claim 2, the substrate sticking process is carried out by absorbing any one substrate to the lower base plate via the elastic body on which absorption opening is formed, and performing position alignment, and then pressing and sticking sealing materials between the pair of substrates. Although the planar machining degree of the upper and lower base plates is not sufficient, it is possible to pressurize them equally with sticking the pair of substrates simultaneously to thereby remove the pressurizing process for press the necessary sealing materials after the conventional substrate sticking process, and achieve simplification of the manufacturing process. In addition, as

the pitch of the absorption opening in the elastic body is made to be n(n is a integral number) times or 1/n times the pitch of the absorption groove or opening in the lower base plate to thereby suppress pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate, and accomplish liquid crystal panel with equal cell gaps.

【009】 According to the manufacturing method of the liquid crystal panel described in claim 3, the vacuum degree of the vacuum absorption of the substrate formed by the upper and lower base plates in the substrate sticking process, is preferable to be maintained below $0.1 \times 1.33322 \times 10^2$ Pa, and the vacuum degree of the vacuum chamber is preferable to be maintained from $0.5 \times 1.33322 \times 10^2$ Pa to $1.0 \times 1.33322 \times 10^2$ Pa.

【0010】 According to the apparatus for sticking substrates described in claim 4, the apparatus includes an upper and lower base plates provided with absorption groove or opening at respective absorption surfaces of the substrates, a pair of substrates are absorbed to the upper and lower base plates so as to be maintained at predetermined intervals thereby enabling position alignment, the pair of substrates can be pressurized via the upper and lower base plates between the substrates, incidentally an elastic body with an absorption opening is arranged to an absorption surface of the lower base plate, and a pitch of the absorption opening in the elastic body is n (n is integral number) times or 1/n times a pitch of the absorption groove or opening of the lower base plate.

【0011】By using the substrate sticking apparatus described in claim 4, it is possible to perform the substrate sticking process of claim 1 to thereby obtain simplification of the manufacturing process.

【0012】According to the apparatus described in claim 5, the upper base plate and the lower base plate provided with the elastic body are arranged in the chamber, in which inner pressure can be adjusted.

【0013】By using the substrate sticking apparatus described in claim 5, it is possible to perform the substrate sticking process of claim 2 or claim 3 to thereby obtain simplification of the manufacturing process.

【0014】

【Embodiment of the Invention】The preferred embodiment of the present invention will now be explained with reference to the appended drawings. FIG. 1 is a schematic view showing substrates sticking process in a method for manufacturing a liquid crystal panel according to first embodiment of the present invention, wherein FIG.1(a) is a cross-sectional view, FIG. 1(b) is a planar view of the elastic body 5, and FIG. 1(c) is a planar view of a base plate 1. FIG. 2 is a schematic view showing sticking process of substrate in a method for manufacturing a liquid crystal panel according to the present invention. Further, FIG. 1 shows a case in which the filling of liquid crystal is performed by vacuum injection method, FIG. 2 shows a case in which it is performed by dropping of the liquid crystal.

【0015】Hereinafter, seven pairs of amorphous silicon TFT liquid crystal panels are manufactured for tests, with changing the manufacturing conditions, and comparisons are carried out.

【0016】 First, seven pairs of TFT array substrate and color substrate, in which a panel having a size of 300 mm ×400 mm and 10. 4 inches is subjected to patterning on two surfaces, have been prepared, and cleaning, forming alignment film made of polyimide on the respective substrate, hardening, and desired rubbing have been performed.

【0017】 Next, spacer particles 7 made of resins and having particle diameter of 4.5 μm has been applied on the array substrate at a ratio of 100 ~ 200 per mm², and ultra violet ray hardening type sealing resins 6, in which 2.0% glass fiber having a fiber length of 5.5 μm is mixed, are formed on a color filter by using screen printing. In this instance, patterns with injection opening have been formed on the first to fourth pairs of color filter substrates, and patterns without injection opening have been formed on the fifth to seventh pairs of the color filter substrates.

【0018】 Sticking process has been carried out using the above seven pairs of array substrates and the color filter substrates as below.

【0019】 First of all, initial pair of substrates has been stuck by conventional manufacturing method. As shown in FIG. 3, the color filter substrate has been absorbed to a lower base plate 2 as lower substrate 4, and the array substrate has been absorbed to the upper base plate 1 as upper substrate 3, then the upper and lower substrates 3, 4 are maintained at a predetermined intervals to align them, and then they have been stuck to each other.

【0020】 Next, the stuck substrates have been withdrawn from the substrate sticking apparatus, and the sealing resins have been pressed by performing vacuum pack(pressurizing process), and then the sealing resins have been hardened by radiation of the ultra violet rays.

【0021】 As shown in FIG. 1(a), those substrates selected from the second pair of color filter substrates to the fourth color filter substrates have been stuck through inserting elastic body 5 between the lower base plate 2 of the substrate sticking apparatus and the lower substrate 4. In this instance, the elastic body made of silicon rubber has a thickness of 1.2 ㎜, and the pitch 52 of an absorption hole 51 thereof shown in FIG. 1(b) is 6 ㎜, 10 ㎜, 24 ㎜ respectively. Further, a pitch 22 of an absorption groove 21 formed at lower base plate 2 was 12 ㎜. Detailed description thereof will be made below.

【0022】 The color filter substrate is vacuum absorbed on the lower base plate 2 as the lower substrate 4 via the elastic body 5, and the array substrate is vacuum absorbed on the upper base plate 1 as the upper substrate 3, and then maintain the upper and lower substrates 3, 4 at a predetermined distance to thereby align the positions thereof, and the sealing resins 6 were pressed sufficiently with the force of 1.5 tons after sticking the upper and lower substrates 3, 4 via the upper and lower base plates 1, 2. In this instance, it is necessary to form an absorption hole 51 at the elastic body 5, which is provided between the lower base plate 2 and the lower substrate 4, so that the upper and lower substrates 3, 4 can be maintained to its aligned position and the upper and lower base plates 1, 2 can be fixed by vacuum absorption. The pitches 52 of the absorption holes 51 formed at the elastic body 5, which have been utilized in the process of assembling the second, third, and fourth color filter substrates, were respectively 10 ㎜, 6 ㎜, and 24 ㎜.

【0023】 Next, the stuck substrates (from the second to the fourth pair of substrates) were withdrawn from the sticking apparatus, and then the sealing resins 6 were hardened by radiation of the ultra violet rays.

【0024】 Then, periphery portions of the above stuck substrates were sheared, and liquid crystal materials were filled by employing vacuum injection method, and then the injection opening were sealed to thereby manufacture a liquid crystal panel.

【0025】 Further, as shown in FIG. 2, the substrates selected from the fifth pair to the seventh pair were stuck, as were in the case of sticking the substrates selected from the second to fourth pair of substrates, via the elastic body 5 inserted between the lower base plate 2 of the substrate sticking apparatus and the lower substrate 4, after dropping liquid crystal materials 8 on the color filter substrate as water drops. Detailed description thereof will be made below. Also, the elastic body 5 and the lower base plate 2 shown in FIG. 2 are illustrated in FIGs. 1(b) and 1(c) in planar view.

【0026】 The color filter substrate on which liquid crystal materials 8 have been dropped as water drops, is vacuum absorbed on the lower base plate 2 as the lower substrate 4 via the elastic body 5, and the array substrate is vacuum absorbed on the upper base plate 1 as the upper substrate 3, then vacuum absorption has been performed in a vacuum chamber 9 to form vacuum having vacuum degree of from $0.5 \times 1.33322 \times 10^2$ Pa to $1.0 \times 1.33322 \times 10^2$ Pa. In this instance, the vacuum degree of the vacuum absorption of the substrates by the upper and lower base plates 1,2 was below $0.1 \times 1.33322 \times 10^2$ Pa.

【0027】 Further, when the vacuum degree of the vacuum chamber 9 is less than $0.5 \times 1.33322 \times 10^2$ Pa, the vacuum absorption force of the upper substrate 3 to the upper base plate 1 becomes insufficient, or the absorption force of the lower substrate 4 to the lower base plate 2 via the elastic body 5 becomes insufficient to thereby result in the dropping of the upper substrate 3 or misalignment of the

substrates. In addition, when the vacuum degree in the vacuum chamber 9 exceeds 1.0 $\times 1.33322 \times 10^2$ Pa, air drops will remain in the fabricated liquid crystal panel. Also, when the vacuum degree of the vacuum absorption in the substrate formed by the upper and the lower base plate 1,2 exceeds 0.1 $\times 1.33322 \times 10^2$ Pa, the vacuum absorption force of the upper substrate 3 to the upper base plate 1 or the absorption force of the lower substrate 4 to the lower base plate 2 via the elastic body 5 becomes insufficient to thereby, as described above, result in the dropping of the upper substrate 3 or misalignment of the substrates. It is preferred that the vacuum absorption force of the substrates formed by the upper and lower base plates 1, 2 becomes closer to 0 Pa, and in principle it is best when the vacuum degree is 0 Pa, however, in actual there exists limitations in the possible vacuum degree due to design limitations of the pump operation part and the vacuum system, therefore, the critical vacuum degree in the present embodiment of the invention was $0.05 \times 1.33322 \times 10^2$ Pa. Also, silicon rubber was utilized for the elastic body 5 in the present embodiment of the invention. As the porous elastic body may expand in openings, it cannot be employed. Further, materials having high elasticity coefficient (that is, solid materials) including a paper, are not preferred because the pressurization would be carried out unequally, so it is considered that materials having small elasticity coefficient are preferred as the elasticity body 5.

【0028】 With maintaining the vacuum chamber 9 at the vacuum degree explained above, position alignment of the upper and lower substrates 3, 4 are performed with proper intervals maintained between the substrates, and then the upper and lower substrates 3, 4 are stuck and the sealing resins are sufficiently pressed with the force of 1.5 tons via the upper and lower base plates. In this instance, it

is necessary to fix the upper and lower base plates 1,2 by vacuum absorption so that position alignment of the upper and lower substrates 3, 4 can be maintained, and also it is necessary to empty the absorption opening 51 formed at the elastic body 5, which is arranged between the lower substrate 4 and the lower base plate 2. The pitches of the absorption openings 51 formed at the elastic body 5, which were employed in assembling the fifth, sixth, and seventh pairs of color filter substrates, were respectively 10 ㎜, 6 ㎜, and 24 ㎜.

【0029】 Next, the fifth to seventh pairs of substrates which have been completed of sticking, are withdrawn from the substrate sticking apparatus, and then hardening of the sealing resins 6 are performed by radiation of the ultra violet rays, and the periphery portions of the substrates are cut to thereby fabricate the liquid crystal panel. Thus, when the liquid crystal materials 8 have been dropped as water drops before the sticking of the substrates, it is possible to abridge the processes of vacuum injection, and closing of the injection opening (sealing of the opening).

【0030】 Then, measurements of the cell gaps (100 points in the surface) of the first to seventh pairs of liquid crystal panels manufactured by the above stated process have been performed. Further, after mounting periphery circuits and displaying the panels, an estimation of the display uniformity is performed with naked eyes. The results obtained are represented in Table 1. The uniformity 3δ in the cell gaps represented in Table 1 is three times the standard deviation δ, supposing that the non-uniformity of the measured values is normal distribution in case of the cell gaps measurements.

【0031】

Assembling No. of pair of substrates	Pitch of the absorption opening in elastic body(㎜)	Machining process or not after sticking	Vacuum injection /opening closing process or not	Uniformity (3δ) Of the cell gaps(㎛)	Estimation of display uniformity with naked eyes
1	Elastic body none	Exist	Exist	0.21	○
2	10	None	Exist	0.26	Δ~○
3	6	None	Exist	0.21	○
4	24	None	Exist	0.20	○
5	10	None	None	0.28	○
6	6	None	None	0.20	○
7	24	None	None	0.22	○

○ : good

Δ : non-uniformity does not exist in displaying the identical intervals of the pitches

【0032】 As apparent from Table 1, in order to obtain identical degree of cell gap with the conventional manufacturing method for the first pair of substrates, as were the fourth and seventh pair of substrates, it is necessary for the pitch 52 of the absorption opening 51 formed at the elastic body 5, which is inserted between the lower substrate 4 and the lower base plate 4 to be n (n is integral number) times the pitch 22 of the absorption groove 21 of the lower base plate 2, and it is

necessary for the pitch 22 of the absorption opening 21 of the lower base plate 2 to be n (n is integral number) times the pitch 52 of the absorption opening 51 formed at the elastic body 5, that is, the pitch 52 of the absorption opening 51 formed at the elastic body 5 to be 1/n (n is integral number) times the pitch 22 of the absorption opening 21 of the lower base plate 2, as were the third and sixth pair of substrates.

【0033】 When the pitch 52 of the absorption opening 51 formed at the elastic body 5 and the pitch 22 of the absorption opening 21 of the lower base plate 2 do not meet the above explained relationship, display inequality of the pitches will arise depending on the least common multiple selected from the pitch 52 of the absorption opening 51 and the pitch 22 of the absorption groove 21 (second pair and fifth pair of substrates). This is because gap inequality will arise from the addition of the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body 5 and the absorption groove 21 of the lower base plate 2, to the load applied to the upper and lower substrates 3, 4 at the time of pressurizing of the substrate sticking. However, the uniformity of the cell gaps can be achieved by overcoming the interference based on the design explained above.

【0034】 As explained above, with regard to the substrate sticking process, the lower substrate 4 is absorbed to the lower base plate 2 via the elastic body 5 at which the absorption opening 51 is formed, the pitch 52 of the opening 51 being identical with n (n is integral number) times or 1/n (n is integral number) times the pitch 22 of the absorption groove 21 formed at the lower base plate 2, and performing position alignment of the upper and lower substrates 3, 4, and then the substrates are pressurized to be stuck by pressing the sealing resins 6 via the

upper and lower base plates 1, 2. Accordingly, although the planar machining degree of the upper and lower base plates 1, 2 is insufficient, since the upper and lower substrates 3, 4 can be stuck and pressurized simultaneously equally, it is not necessary to perform pressurizing process for press sealing resins required for the process following the conventional substrate sticking process to thereby achieve simplification of the manufacturing process, and to produce liquid crystal panel having uniform cell gaps.

【0035】 Further, as shown in FIG. 1 (c), when the absorption groove 21 formed at the lower base plate 2 has been arranged with the pitch 22 in the x direction (transversal direction), the absorption opening 52 of the elastic body 5 is arranged with the pitch 52 in the x direction (transversal direction), and the pitch 52 meets the relationship of n (n is integral number) times or 1/n times the pitch 22. In this case, although the pitch in the y direction (longitudinal direction) of the absorption opening 51 of the elastic body 5 may not be identical with the pitch 52 in the x direction, the absorption opening 51 is preferable to be arranged at equal pitch (equal intervals) in the y direction. In addition, it is possible to obtain the overlap between the absorption opening 51 of the elastic body 5 and the absorption groove 21 of the lower base plate 2 sufficiently by increasing the number of the absorption opening 51 in the elastic body 5 in practical, although the position of the absorption openings 51 are not particularly adjusted.

【0036】 Whereas, when the absorption opening is formed at the lower base plate 2, and not the absorption groove 21, the absorption opening is aligned and arranged at equal pitch (equal intervals) in the x and y directions respectively together with the absorption opening 51 of the elastic body 5. In such case, the pitch 52 in the x direction of the absorption opening 51 formed at the elastic body

5 meets the relationship of n (n is integral number) times or 1/n times the pitch of the absorption groove 21 of the lower base plate 2, and the pitch in the y direction of the absorption opening 51 formed at the elastic body 5 meets the relationship of n (n is integral number) times or 1/n times the pitch in the y direction of the absorption opening formed at the lower base plate 2. Also, in such a case, it is possible to obtain the overlap between the absorption opening 51 of the elastic body 5 and the absorption opening of the lower base plate 2 sufficiently by increasing the number of the absorption opening 51 in the elastic body 5 in practical, although the position of the absorption openings 51 is not particularly adjusted.

【0037】 Also, the absorption groove or absorption opening (not shown) should be formed at the absorption surface of the upper base plate 1 to absorb the upper substrate 3.

【0038】 As stated above, the substrate sticking apparatus shown in FIG. 1 comprises an upper base plate 1 and a lower base plate 2, each being provided with an absorption groove or an absorption opening at the absorption surface thereof. Also, in the above apparatus, it is possible to maintain a distance between the upper and lower substrates absorbed to the upper and lower base plates 1, 2 respectively to be constant to thereby align them. In addition, the upper and lower substrates 3, 4 may be constructed to be pressurized with interposing the upper and the lower base plates 1, 2, and simultaneously an elastic body 5 with an absorption opening 51 is arranged on a substrate absorption surface of the lower base plate 2. Further, a pitch of the absorption opening 51 formed at the elastic body 5 is made to meet the above stated relationship.

【0039】 In addition, the substrate sticking apparatus shown in FIG. 2 includes the substrate sticking apparatus shown in FIG. 1 in a chamber 9 wherein the inner pressure can be adjusted.

【0040】 Further, in the present embodiment of the invention, although the elastic body 5 has been constructed of a silicon rubber, however as the elastic body 5, for example, it can also be made of dual layer structure elastic body disclosed in Japanese Patent Laid-Open Publication No. Hei 11-264991 (Japanese Patent application No. Hei 10-136924), which consists of a soft portion and a hard portion. Then, as explained in the above embodiment of the present invention, the absorption opening 51 is formed at the elastic body 5 so that the hard portion thereof can be contacted with the lower substrate 4 to improve the uniformity of the cell gap in the panel surface.

【0041】 Also, as shown in FIGs. 1 and 2, in the embodiment of the present invention, although the present invention has been explained in connection with the spacer particles 7 to be applied on the upper substrate 3, the spacer particles 7 can also be applied on the lower substrate 4. Further, instead of applying the spacer particles 7, photo-sensitive resins can be applied to form protrusion pattern by applying photo lithography technology or protrusion may be formed by printing the resins, on any one substrate of the upper and lower substrates 3, 4.

【0042】 In addition, as shown in FIG. 1, although the sealing resins 6 have been formed on the lower substrate 4 to attach the upper and lower substrates 3, 4 and seal the liquid crystal, they can also be formed on the upper substrate 3 instead of forming them on the lower substrate 4. However, it is preferable to form the

sealing resins 6 on the lower substrate 4 at which the liquid crystal materials 8 have been dropped, in case of FIG. 2.

【0043】 Further, although the color filter substrate has been used as for the lower substrate 4 and the TFT array substrate 3 has been used as for the upper substrate 3 in the embodiment of the present invention, also the color filter substrate can be used as for the upper substrate 3 and the TFT array substrate 4 can be used for the lower substrate 4.

【0044】

【Effects of the Invention】

As described above, according to the present invention, with regard to the substrate sticking process, the lower substrate is absorbed to the lower base plate via the elastic body at which the absorption opening is formed, the pitch of the opening being identical with n (n is integral number) times or 1/n times the pitch of the absorption groove or absorption opening formed at the lower base plate, and performing position alignment of the upper and lower substrates, and then the substrates are pressurized to be stuck by pressing the sealing resins via the upper and lower base plates. Accordingly, although the planar machining degree of the upper and lower base plates is insufficient, since the upper and lower substrates can be stuck and pressurized simultaneously uniformly, it is not necessary to perform pressurizing process for press the sealing resins required for the process following the conventional substrate sticking process to thereby achieve the simplification of the manufacturing process, and to produce liquid crystal panels having uniform cell gaps.

【Description of Drawings】

FIG. 1(a) is a schematic cross-sectional view showing a substrate sticking process in a method for manufacturing a liquid crystal panel according to the first embodiment of the present invention;

FIG. 1(b) is a schematic planar view of an elastic body 5;

FIG. 1(c) is a schematic planar view of a lower base plate;

FIG. 2 is a schematic cross-sectional view showing a substrate sticking process in a method for manufacturing a liquid crystal panel according to the second embodiment of the present invention; and

FIG. 3is a conventional schematic cross-sectional view showing a substrate sticking process in a method for manufacturing a liquid crystal panel.

【Explanation of Numerals】

1: upper base plate 2: lower base plate

21: absorption groove formed at the lower base plate

22: pitch of the absorption groove in the lower base plate 3: upper substrate 4: lower substrate

5: elastic body 51: absorption opening of the elastic body

52: pitch of the absorption opening in the elastic body

7: spacer particle 8: liquid crystal materials

9: vacuum chamber